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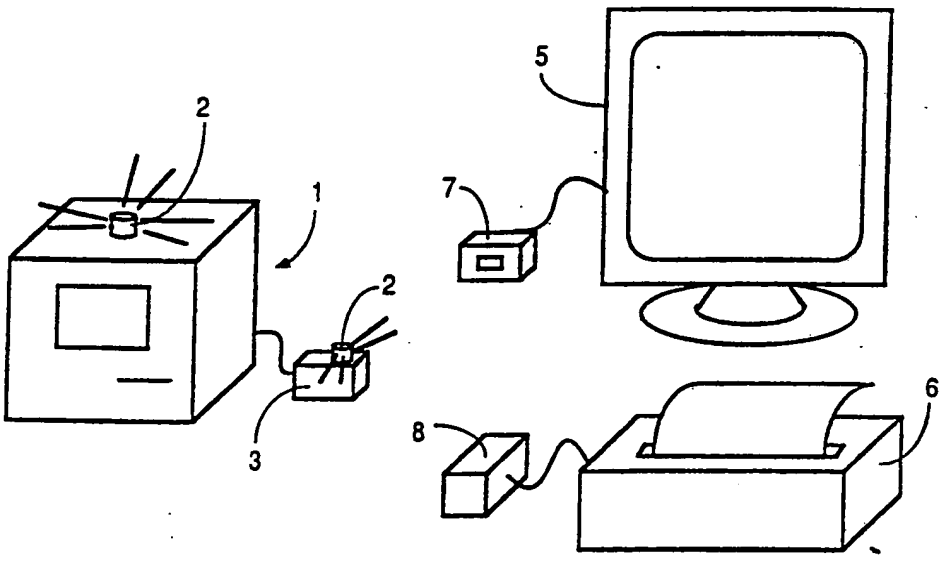
(54) Title: WIRELESS TRANSMITTING AND RECEIVING DEVICE WITH SELECTABLE CHANNEL SETTINGS



(57) Abstract

A wireless transmitting device (3) is disclosed herein which outputs an infrared signal and which is settable by a user or settable by a computer (1) to transmit a particular one of a plurality of channel codes within the infrared signal along with any control information. In the preferred embodiment, the wireless transmission device (3) is controlled by a personal computer (1) to provide channel code and control information to one or more peripheral devices (5, 6). A compatible infrared receiver (7) associated with each of the peripheral devices is also settable, either by the user or by other means, to only pass control information to the peripheral device if the particular channel code outputted by the transmission device is recognized by the receiver.

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WIRELESS TRANSMITTING AND RECEIVING DEVICE WITH SELECTABLE CHANNEL SETTINGS

CROSS-REFERENCE TO RELATED APPLICATIONS

This application relates to copending application Serial No. 07/650,846, entitled "Wireless Input Device With Selectable Channel Settings," by the present inventors and assigned to the same assignee as the present application.

FIELD OF THE INVENTION

This invention relates to wireless transmitting/receiving devices and, in particular, to a wireless transmitting device operated by a personal computer for remotely controlling a peripheral device.

BACKGROUND OF THE INVENTION

Wireless transmitting devices for controlling personal computers or other types of controllable apparatus are well known. One such wireless device communicates with a compatible remote receiver via radio frequencies (RF) or an infrared beam. In these types of wireless devices, a device of a particular model which communicates with an associated compatible receiver may also freely communicate with other identical receivers coupled to other controllable devices. In other words, a conventional wireless device of a particular model is interchangeable with other devices of the same model.

This is advantageous for the manufacturer, since the manufacturer can pair up any wireless device of a certain model with any compatible model receiver. This may also

be advantageous for the user, since only a single wireless device may be used to communicate with a number of different controllable devices, each connected to a separate compatible receiver.

However, in some cases it may not be desirable for the output signal of a single transmitter to control two or more devices, each connected to a separate receiver. For example, if two receivers, coupled to separate controllable devices, are proximate to each other and the output radiation of the transmitter is simultaneously received by both receivers, both controllable devices will be controlled by the same transmitted signal even if the user's intent is to only control a single device.

If it were desirable to connect such a prior art transmitter to an output of a personal computer to allow the computer to remotely control one or more peripheral devices, such as a printer, a display means, or the like, such communication with peripheral equipment would suffer from the same drawbacks discussed above.

It is known to provide a wireless transmitting device which communicates with a receiver via RF and, wherein, to avoid interference with other RF signals, the carrier frequency of the device is selectable by the user. A significant drawback of this type of wireless device is that the device's RF transmitter inherently generates a wide beam of RF energy which may unintentionally affect other receivers in the same room, or in a separate room, which are also tuned to receive the carrier frequency outputted by the device.

Thus, what is needed is a wireless transmitting device which can be manually set by the user, or automatically set by a computer, to control only a particular controllable device, and which does not suffer from the above-described drawbacks of the prior art.

SUMMARY OF THE INVENTION

A wireless transmitting device is disclosed herein which outputs an infrared signal and which is settable by a user or settable by a computer to transmit a particular one of a plurality of channel codes within the infrared signal along with any control information. In the preferred embodiment, the wireless transmitting device is controlled by a personal computer to transmit a selected channel code and control information to one or more peripheral devices. A compatible infrared receiver associated with each of the peripheral devices is also settable, either by the user or by other means, to only recognize the particular channel code outputted by the transmitting device. If the received code is recognized by the receiver, the receiver processes any additional control information contained in the transmitted infrared signal so as to control the associated peripheral device, or other controllable device, coupled to an output of the receiver.

Numerous advantages are provided by encoding a channel setting in the infrared signal itself. One such advantage is that extremely simple circuitry may be used to transmit and receive an infrared signal and to encode and decode the channel setting. Another advantage is that a plurality of computers can each communicate with any of a plurality of peripheral devices by automatically selecting a channel code associated with that peripheral device. Each computer may transmit on a different carrier frequency so that the receiver associated with the peripheral device can identify the computer which transmitted the signal.

Thus, an inexpensive wireless transmitting device having selectable channel settings may be controlled by a personal computer or other information processing device to remotely control peripheral devices located proximate to one another or where only authorized control of the peripheral devices is desired. Numerous other

applications will be apparent to those of ordinary skill in the art after reading this disclosure.

BRIEF DESCRIPTION OF THE DRAWINGS

Figs. 1a and 1b show a preferred embodiment of the wireless transmitting device controlled by a personal computer, wherein the output of the wireless transmitting device controls one or more peripheral devices.

Fig. 2 shows a sample packet of digital information outputted by the transmitting devices of Figs. 1, 3, 4, and 5 which contains a channel code.

Fig. 3 illustrates a configuration of personal computers and printers which may take advantage of the transceivers of this invention.

Fig. 4 is a block diagram of a transceiver in accordance with one embodiment of the invention.

Fig. 5 is an exemplary circuit diagram of the transceiver of Fig. 4.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Fig. 1a illustrates one embodiment of the invention, wherein personal computer 1 contains infrared transmission circuitry which transmits modulated infrared radiation, containing information in digital form, through omnidirectional window 2. The bulk of the transmission circuitry may be contained on a circuit board, such as shown in Fig. 1b, inside computer 1.

As an alternative to containing the infrared transmitter circuitry inside the computer housing, an external transmitter 3 connected to an appropriate output port of computer 1 may be provided.

In the embodiment of Fig. 1a, computer 1 provides the information signals to the infrared transmission circuitry, which converts the electrical signals to infrared signals outputted through window 2 secured to either computer 1 or external transmitter 3.

A channel code, further described with respect to Fig. 2, which may be manually set or selected by computer 1, is also outputted by the infrared transmission circuitry. The channel code is set to enable only a particular receiver, responding to the particular transmitted channel code, to process the remaining transmitted control information for controlling an associated peripheral device.

Such a receiver may be contained within peripheral devices 5 and 6 or may be external to devices 5 and 6, such as receivers 7 and 8 in Fig. 1a.

Receivers 7 and 8 or the receivers contained in devices 5 and 6 are set, either manually or by any other suitable means, to only process control information or other information generated by computer 1 which accompanies a transmitted channel code corresponding to the setting of the particular receiver.

In the preferred embodiment, computer 1, when desiring to communicate with peripheral device 6, automatically transmits a predetermined channel code contained in a memory means 9 in Fig. 1b corresponding to the channel code of the receiver associated with device 6. A different channel code may be automatically selected from memory 9 by computer 1 when desiring to communicate with peripheral device 5.

Memory 9 may be any suitable means for storing one or more channel codes, including a plurality of switches. A particular channel code may be automatically selected by computer 1 by providing an address to memory 9 associated with a particular channel code contained in memory 9. The selected channel code would then be read out and transmitted at the appropriate time.

Alternatively, if only a single peripheral device is used, the transmitter channel code setting may be set manually by a suitable switching means, such as rotary switch 10 in Fig. 1b.

Further, if two-way communication is required between computer 1 and any peripheral devices, computer 1 and the peripheral devices may be provided with both a transmitter and a receiver, whereby the various transmitters and receivers would be programmed with the necessary channel codes to enable two-way communication.

If peripheral devices 5 and 6 are sufficiently proximate to one another, a more narrow infrared beam may be sufficient to simultaneously be received by the receivers connected to the peripheral devices. However, if devices 5 and 6 are widely separated, two infrared output devices or a broad beam (e.g., omnidirectional) infrared output device may be required to direct a beam at both devices simultaneously.

Thus, the above-described invention, to be described in more detail with reference to Figs. 2-5, enables selective communication between a computer and peripheral devices without the need for wires and allows the peripheral devices to be placed at virtually any location within the range of the infrared transmitter.

In a preferred embodiment, the channel selected by switch 10 or memory 9 in Fig. 1b causes a unique digital code to be transmitted by transmitter 3 within a bit stream such as that shown in Fig. 2. In the preferred embodiment, asynchronous transmission utilizing start and stop bits is used, including horizontal error correction correlation (e.g., parity bits). Numerous other transmission schemes will be apparent to those of skill in the art which may be used to transmit the bit stream of Fig. 2 via an infrared beam.

Fig. 2 illustrates one embodiment of a packet of information to be transmitted containing a fixed number of bits--in this example, 22 bits. Bits 03-06 (4 bits) uniquely convey one of 16 channel settings selected using 16-position rotable switch 10 in Fig. 1b or selected by memory 9 in Fig. 1b. The information remaining in the transmission packet contains the information necessary to

control a peripheral device or a computer in the desired manner. The packet also contains parity bits and other appropriate information to ensure the reliable transmission of information.

In one embodiment, receiver 8 of Fig. 1a, upon receiving the entire 22 bit packet, first reviews the information, including parity bits, to ensure the information has been accurately transmitted. Well known error correction coding may also be used. Receiver 8 then reviews channel code bits 03-06 to determine whether these bits conform to the channel setting of a switch mounted on receiver 8. If bits 03-06 correctly match the channel setting, the control information contained in the packet is further processed by receiver 8 to be compatible with the particular input/output protocol of printer 6 and supplied to the suitable input ports of printer 6 to appropriately control printer 6. The various protocols for controlling peripheral devices are well known in the art.

The remaining bits in the packet of Fig. 2 will now be described. Bit 01 signals a beginning of an 8-bit octet of information, which enables asynchronous transmission of the bits which follow. Bit 02 indicates the start of a first octet of a packet of information. Bits 03-06 convey channel selection information previously discussed. Bits 07 and 08 define the packet data type so that the receiver will know the type of information contained in the data bits 13-20. Bit 09 contains a parity bit, which is dependent upon the states of bits 02-08 and provides some indication as to whether the bits were accurately received. Bit 10 contains a stop octet bit necessary for asynchronous transmission. Bit 11 contains a start octet bit similar to bit 01. Bit 12 indicates a second octet or continuation of the packet is being transmitted. Bits 13-20 are data bits providing the control information for printer 6. Bit 21 contains a parity bit for the second octet of information. And, bit

22 contains a stop octet bit necessary for asynchronous transmission.

As will be apparent, the format and content of the information transmitted by transmitter 3 may take any suitable form depending upon the particular requirements and the hardware used to implement the transmitter and receiver.

If the disclosed wireless transmitter were incorporated into printer 6 or other peripheral device for transmitting signals to a computer, it would be apparent to one skilled in the art how to provide suitable input signals from the peripheral device to the wireless transmitter to communicate with the computer.

Fig. 3 illustrates one use of the invention to allow three personal computers (PC) 20, 22 and 24 to selectively communicate with any one of three printers 26, 28 and 30. Any combination of other peripheral devices, including hard disk drives, may be substituted for printers 26, 28 and 30.

PC 20 transmits any of channel codes A, B, and C and an information signal on a 44KHz carrier frequency. PC 22 transmits any of codes A, B and C and an information signal on a 48KHz carrier frequency. And, PC 24 transmits any of codes A, B, and C and an information signal on a 52KHz carrier frequency. Each PC may select a code from a number of code settings (e.g., code settings A, B and C) in memory depending on which of printers 26, 28 and 30 that the PC desires to communicate with.

Printer 26 is internally set with a switch or other means to only respond to transmitted commands associated with a transmitted code A. Printers 28 and 30 are set to only respond to commands associated with transmitted code B or C, respectively.

In operation, each of printers 26, 28 and 30 continually scan the frequencies 44KHz, 48KHz and 52KHz to detect whether a signal is being transmitted by either of PC's 20, 22 or 24. If the transmitted signal contains the

proper code A, B or C for that printer, the printer acknowledges receipt of the command, on the same carrier frequency that the command was transmitted on, to the particular PC which transmitted the command. This transmitted acknowledge signal may also include the channel code for added security or may not include the channel code, since such a signal will be on a carrier frequency which can only be received by the intended PC. The communication channel then remains open during which time the PC transmits the data to be printed.

In this manner, any of the three PC's can open a communication channel with any of the three printers. Three printing operations may be ongoing simultaneously without crosstalk, since the communications are on three separate carrier frequencies.

The number of PC's is limited to the number of available carrier frequencies while the number of printers (or other peripheral devices) is generally limited to the number of available channel settings.

Fig. 4 is a block diagram illustrating a construction of a transceiver in accordance with one embodiment of the invention.

Printer or PC interface 40 is connected to a printer or PC and provides the proper voltage levels, connector, etc. necessary for interfacing controller 42 to the printer or PC. Controller 42 may output or receive an 8-bit parallel signal or a serial signal, as appropriate, to/from interface 40.

Channel selector switches or channel code memory 44 provides the channel code to which a received code is compared or which may be transmitted along with an information signal.

Infrared (IR) transmitter 48 provides the conversion of an electrical signal from controller 42 to an IR signal at a carrier frequency determined by timebase 50. Timebase 50 may be fixed or variable, as appropriate, to

allow transmission only at a fixed frequency or at a selected one of a possible plurality of frequencies.

The output of timebase 50 may be selectable by a PC or printer connected to interface 40.

IR receiver 52 provides the conversion of a received IR signal into an electrical signal and receives only those frequencies determined by timebase 50.

Fig. 5 illustrates one embodiment of a circuit which could be used to implement the transceiver of Fig. 4.

In Fig. 5, controller 60 may be a model 8051PLCC microprocessor available from Advanced Micro Devices. Preferably, controller 60 contains program memory so as not to require an external ROM. One of ordinary skill in the art will be easily able to program controller 60 given the requirements described in this disclosure.

Input/output lines 62 are used to communicate an 8-bit parallel signal between controller 60 and the PC or printer.

Rotary switch 64 is used to fix one of 16 channel code settings. Such a switch would be incorporated into a printer housing the IR transceiver, since the channel code for that particular printer will be fixed. However, for a transceiver housed in a PC, the channel code setting may be selectable by the PC using control signals generated by the PC. In the example of Fig. 3, the PC will have to designate one of three channel code settings to communicate with a selected one of three printers.

Phase-locked loop (PLL) 66, which may be a model LM567 from National Semiconductor, is used to generate a timebase so as to cause the transceiver to transmit or receive IR signals on a certain carrier frequency. The frequency at which PLL runs is determined by which of PLL feedback circuits 67-70 are switched on by controller 60 via control lines 71. Each of feedback circuits 67-70 provide a different resistance value in a feedback loop which changes the frequency of PLL 66 accordingly.

For example, if the transceiver of Fig. 5 were incorporated into one of the printers of Fig. 3, in an idle state, controller 60 would cycle through each of feedback circuits 67-70 so as to scan through each of the four receive carrier frequencies of the transceiver. An IR signal having a certain carrier frequency received by photodetector 72 would be properly demodulated and filtered by PLL 66 only during the time when the proper one of switches 67-70 were closed. This properly demodulated signal would then be applied to controller 60 via input line 73.

Controller 60 detects the receipt of this signal during its idle or scanning mode and temporarily stops further scanning in order to further process the transmitted signal packet and channel code. If the channel code does not match that set by switch 64 or by some other channel setting means, controller 60 resumes scanning. If the channel code matches, controller 60 would keep the communication channel open until the entire transmission has been completed (e.g., until printing has been completed).

The same PLL 66 frequency also controls AND gate 74 via line 75 to modulate a signal on line 76 to be transmitted at the PLL carrier frequency. The signal to be transmitted on line 76 is buffered by buffer 80 and then ANDed with the PLL carrier frequency signal. The output of AND gate 74 is then converted to an IR signal by IR transmitter 82.

Crystal 86 provides clocking for controller 60.

Thus, an improved wireless transmission device and receiver have been disclosed, wherein channel selection data is encoded in the output signal of the transmission device and compared with receiver channel selection data. This transmitter device may be controlled by a personal computer or other type of device and used by the computer to remotely control peripheral devices.

While particular embodiments of the present invention have been shown and described, it will be obvious to those skilled in the art that changes and modifications may be made without departing from this invention in its broadest aspects and, therefore, the appended claims are to encompass within their scope all such changes and modifications as fall within the true spirit and scope of this invention.

CLAIMS

What is claimed is:

1. A wireless transmission and receiving system comprising:

a transmitter, connected to an information processing device, for outputting an infrared signal corresponding to input signals generated by said information processing device; and

a receiver, connected to a peripheral device remote from said information processing device, for receiving said infrared signal and causing said peripheral device to be controlled in accordance with said input signals generated by said information processing device.

2. The system device of Claim 1 further comprising a first channel selection means, wherein a channel setting of said first channel selection means is encoded into a data stream outputted by said transmitter for being decoded by said receiver.

3. The system of Claim 2 wherein said data stream includes said channel setting in conjunction with other information signals generated by said information processing device for controlling said peripheral device connected to said receiver.

4. The system of Claim 2 wherein said first channel selection means is a memory means incorporated in said information processing device which contains a channel setting code which is encoded into said data stream.

5. The system of Claim 2 wherein a carrier frequency of said infrared signal outputted by said transmitter may be selected from a plurality of carrier frequencies, and said receiver scans said plurality of carrier frequencies.

6. A wireless input device incorporating a first channel selection means, wherein a channel setting of said first channel selection means is encoded into a data stream outputted by said wireless input device for being decoded by a receiver, said data stream also including control signals generated by an information processing means for communicating with a peripheral device connected to said receiver.

7. The input device of Claim 6 wherein said data stream outputted by said input device is in a form of an infrared signal.

8. The input device of Claim 6 wherein said first channel selection means includes a memory means containing said channel setting which is encoded into said data stream.

9. The input device of Claim 6 wherein a portion of said input device is housed within a personal computer.

10. The input device of Claim 6 wherein said input device is completely housed within a personal computer.

11. A receiver containing a channel selection means which generates a receiver channel code, wherein said receiver compares said receiver channel code to a transmitted channel code to determine whether said receiver channel code is identical to said transmitted channel code, said receiver being coupled to control a peripheral device whose operation is remotely controlled by an information processing means controlling an output of a wireless transmitter.

12. The receiver of Claim 11 wherein said receiver blocks transmitted data containing said transmitted channel code from controlling said peripheral device if

said receiver channel code and said transmitted channel code do not match and applies data signals to said peripheral device to control said peripheral device if said receiver channel code and said transmitted channel code match.

13. The receiver of Claim 12 wherein said transmitted data is transmitted in the form of an infrared signal.

14. The receiver of Claim 12 wherein said receiver scans a range of carrier frequencies to detect a carrier frequency containing said transmitted data.

15. A method of communicating between one or more computers and one or more peripheral devices comprising the steps of:

transmitting a first signal generated by a first computer containing a first channel code on a first carrier frequency;

scanning, by a first peripheral device, a plurality of carrier frequencies until said first signal generated by said first computer is detected;

detecting, by said first peripheral device, said first channel code to determine whether said first channel code matches a channel code to which said first peripheral device is set.

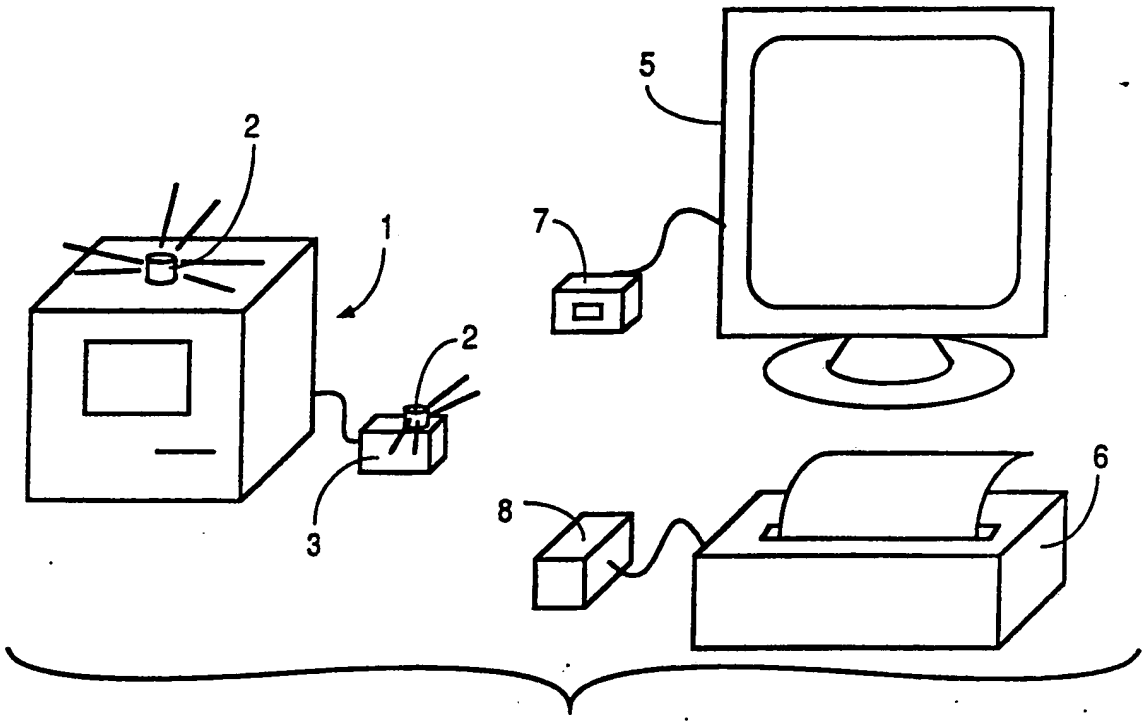


FIG. 1a

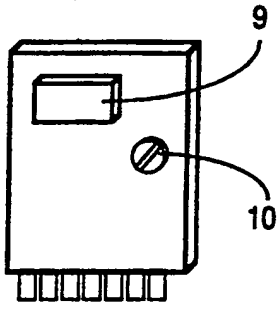


FIG. 1b

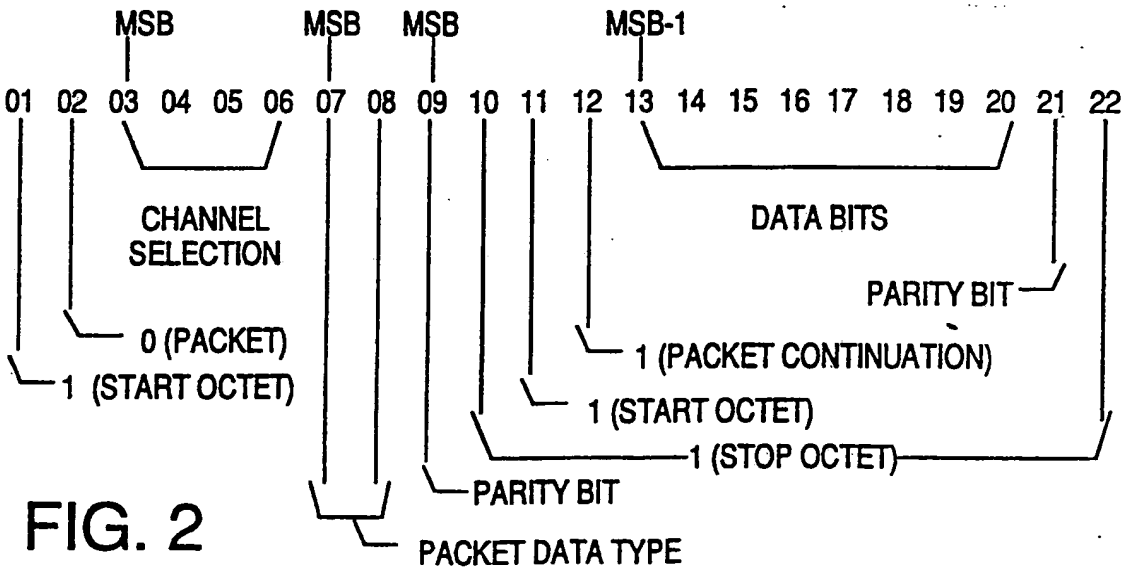


FIG. 2

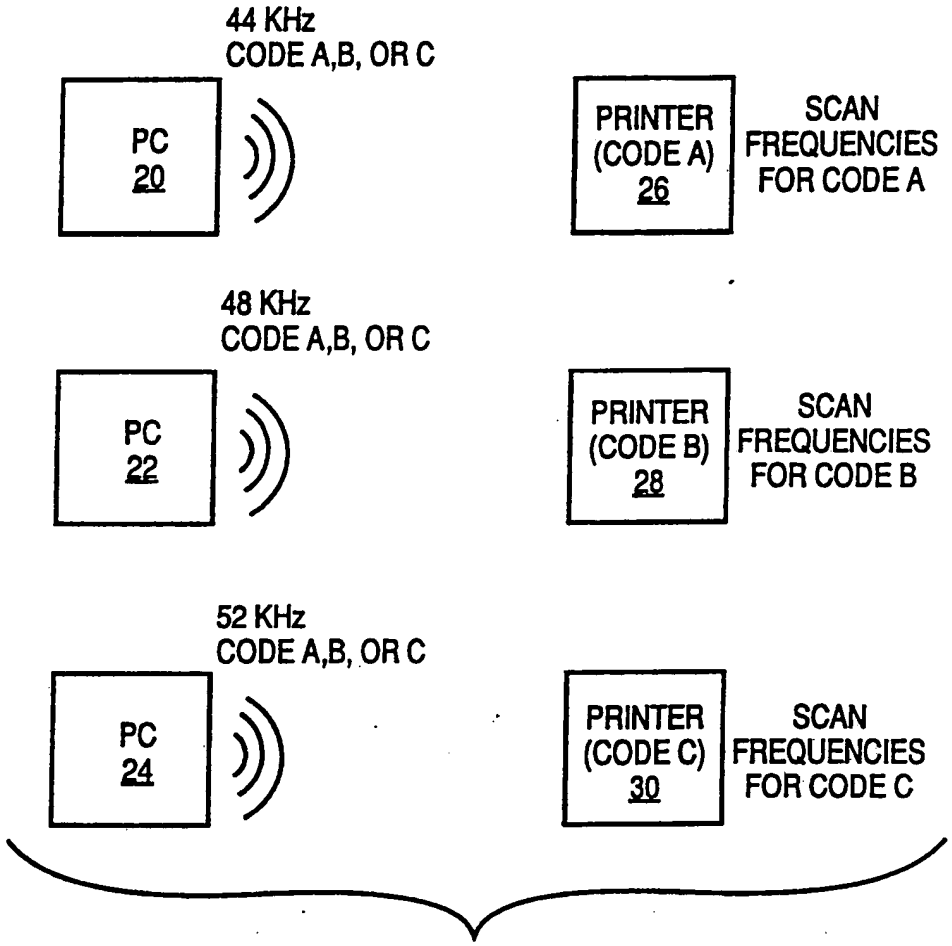

44 KHz
CODE A,B, OR C
PC
20
PRINTER
(CODE A)
26
SCAN
FREQUENCIES
FOR CODE A
48 KHz
CODE A,B, OR C
PC
22
PRINTER
(CODE B)
28
SCAN
FREQUENCIES
FOR CODE B
52 KHz
CODE A,B, OR C
PC
24
PRINTER
(CODE C)
30
SCAN
FREQUENCIES
FOR CODE C

FIG. 3

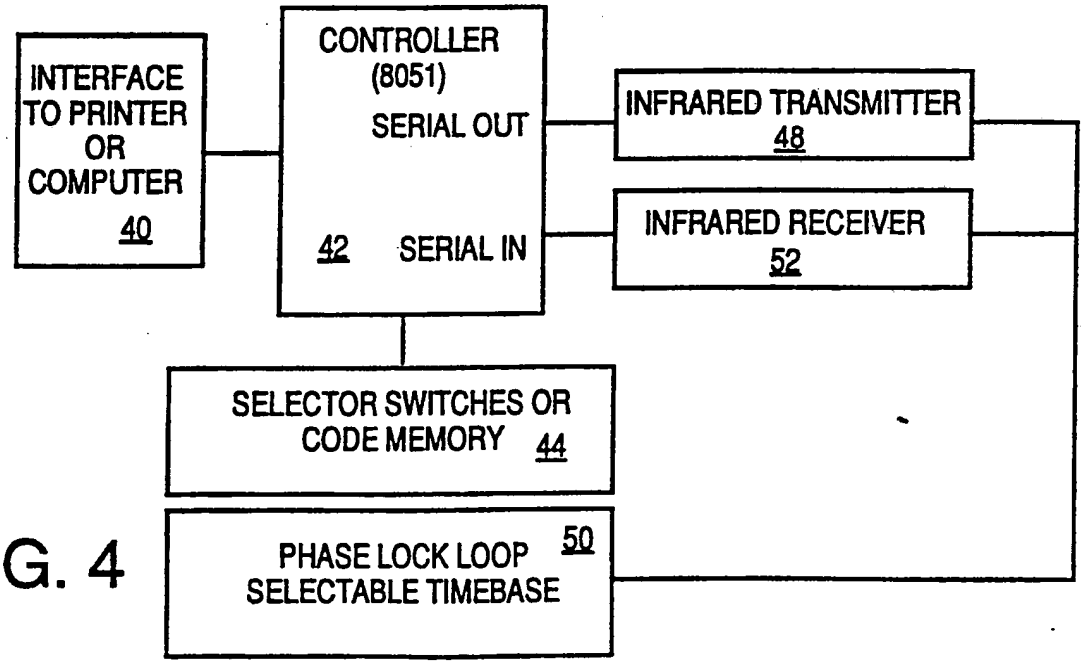
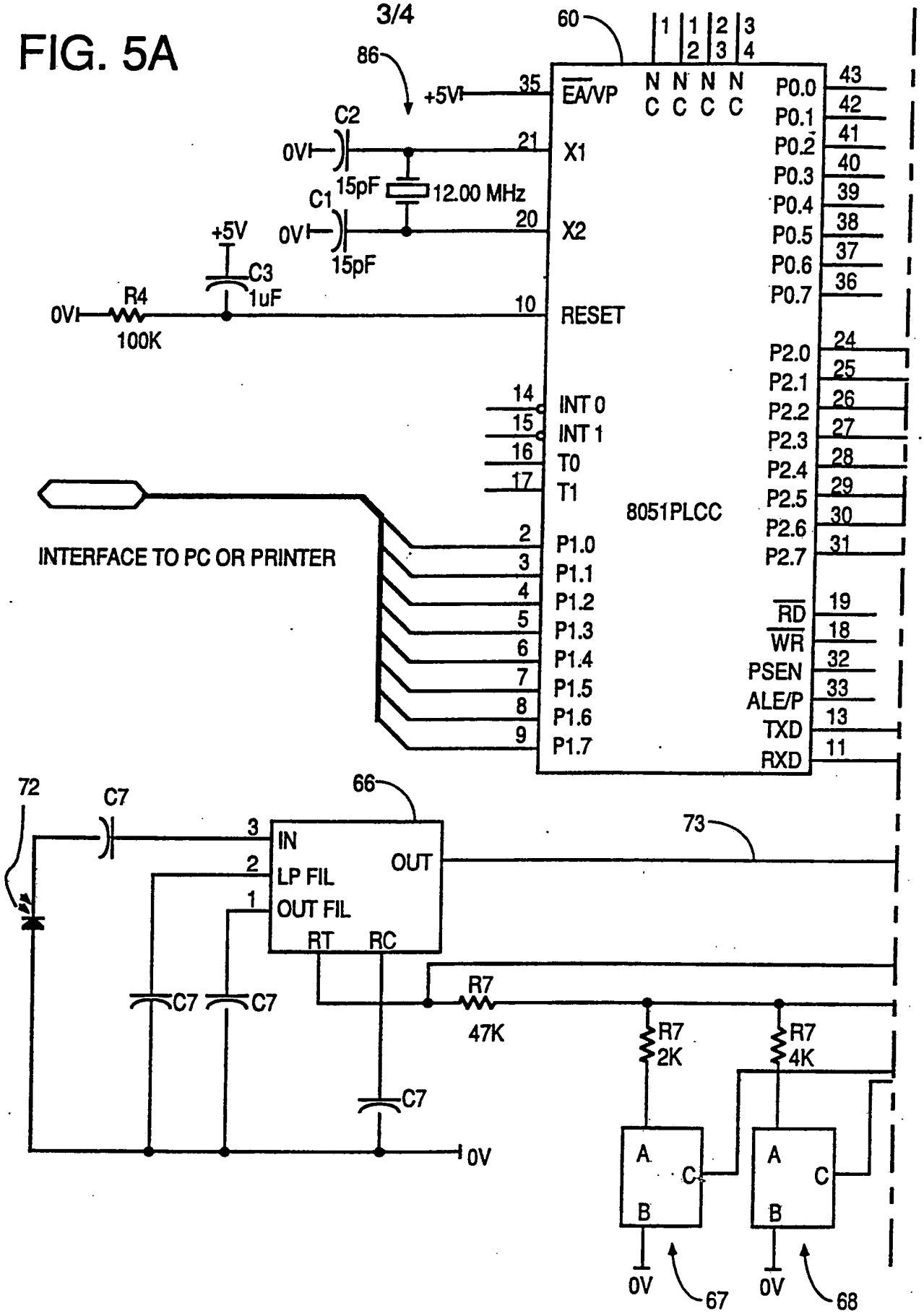

INTERFACE
TO PRINTER
OR
COMPUTER
40
CONTROLLER
(8051)
SERIAL OUT
42
SERIAL IN
INFRARED TRANSMITTER
48
INFRARED RECEIVER
52
SELECTOR SWITCHES OR
CODE MEMORY
44
PHASE LOCK LOOP
SELECTABLE TIMEBASE
50

FIG. 4

FIG. 5A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+5V
35
EA/VP
C2
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21
X1
15pF
12.00 MHz
C1
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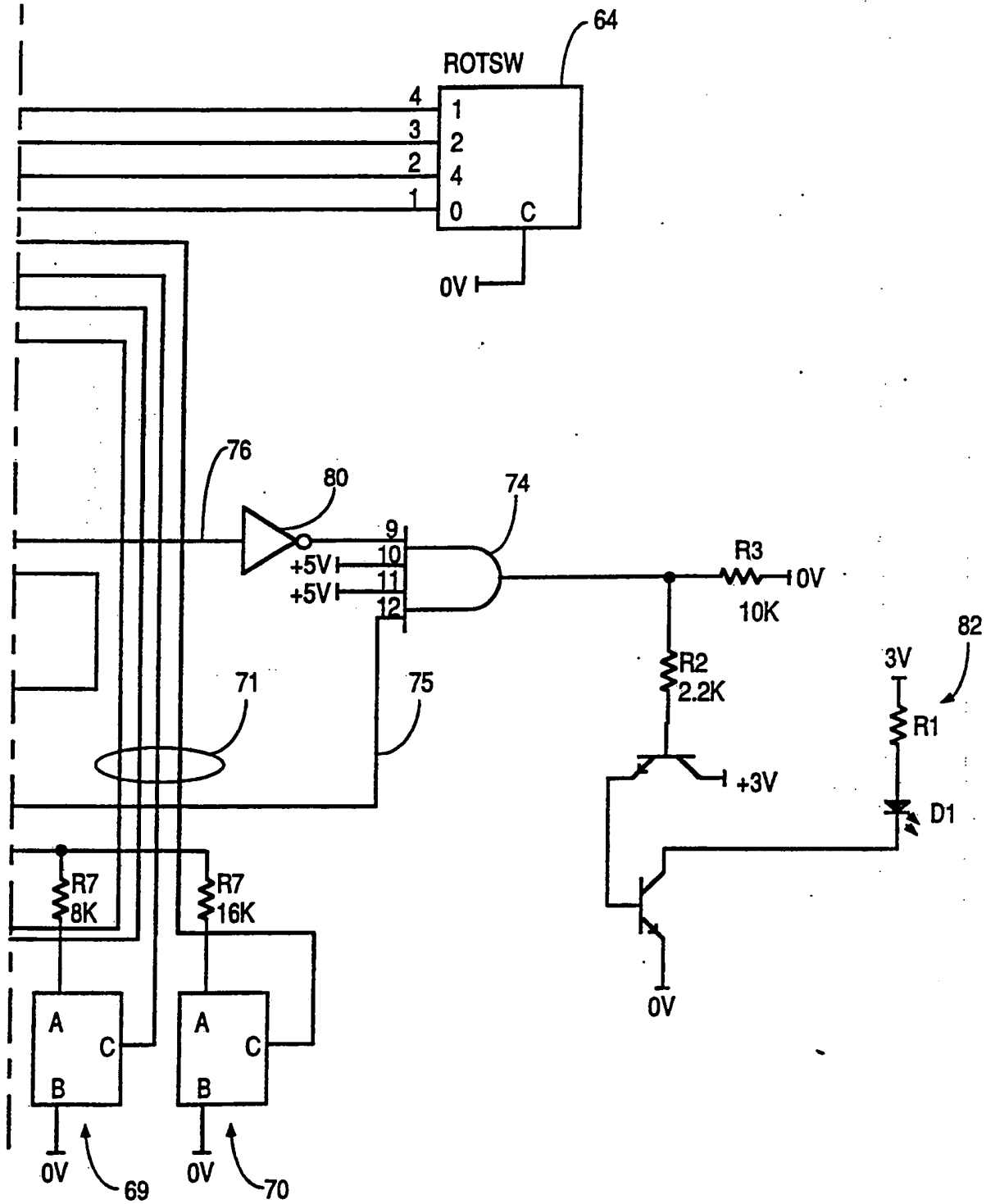
20
X2
15pF
C3
1uF
R4
0V
100K
10
RESET
14
INT 0
15
INT 1
16
T0
17
T1
8051PLCC
INTERFACE TO PC OR PRINTER
2
P1.0
3
P1.1
4
P1.2
5
P1.3
6
P1.4
7
P1.5
8
P1.6
9
P1.7
P0.0
P0.1
P0.2
P0.3
P0.4
P0.5
P0.6
P0.7
P2.0
P2.1
P2.2
P2.3
P2.4
P2.5
P2.6
P2.7
RD
WR
PSEN
ALE/P
TXD
RXD
72
C7
66
3
IN
2
LP FIL
1
OUT FIL
OUT
RT
RC
73
C7
C7
R7
47K
R7
2K
R7
4K
C7
0V
A
B
C
0V
67
0V
68

FIG. 5B

KEY TO FIG 5

FIG. 5A	FIG. 5B



INTERNATIONAL SEARCH REPORT

PCT/US92/08696

A. CLASSIFICATION OF SUBJECT MATTER

IPC(5) :H04B 10/00
US CL :340/825.720

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : Please See Extra Sheet.

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y	US,A, 4,727,600 (Avakian) 23 February 1988 Note Abstract, Figure 4, Figure 12.	1-4,6-13 5,14,15
Y	US,A, 4,423,413 (Dasilva) 27 December 1983 Note Figure 1; Figure 2, item 8.	5,14,15
Y	US,A, 4,155,040 (Harmon et al.) 15 May 1979 Note Col. 1, lines 35-41.	5,14,15
Y	US,A, 4,771,283 (Imoto) 13 September 1988 Note Figure 1, items 11,12,21,18; Col. 4, lines 33-50.	5,14,15
A	US,A, 4,947,162 (Kimura) 07 August 1990 Note Col. 1, lines 25-45, manual address setting.	2,4,8

[X] Further documents are listed in the continuation of Box C. [ ] See patent family annex.

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"A"	document defining the general state of the art which is not considered to be part of particular relevance	"X"	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
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"L"	document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"&"	document member of the same patent family
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C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
P,X	US,A, 5,081,711 (Rickman, Jr.) 04 January 1992 Note Abstract, Figure 1.	1-4,6-13
P,X	US,A, 5,099,346 (Lee et al.) 24 March 1992 Note Abstract.	1-4,6-13

B. FIELDS SEARCHED
Minimum documentation searched
Classification System: U.S.

340/825,720 340/539,825.03,825.07,825.08,825.1,825.11,825.52,825.72,825.73,825.76,825.04; 455/32.1; 358/194.1; 359/157,172,164,165,167,142,143,146